PATENT SPECIFICATION

Application Date: Sept. 25, 1936. No. 26058/36. 476,833
" " May 11, 1937. No. 13423/37.
One Complete Specification Left: July 16, 1937.
(Under Section 16 of the Patents and Designs Acts, 1907 to 1932.)
Specification Accepted: Dec. 16, 1937.

PROVISIONAL SPECIFICATION
No. 26058 A.D. 1936.

Improvements in or relating to High-Pressure Metal-Vapour Electric Discharge Lamps

We, THE GENERAL ELECTRIC COMPANY LIMITED, of Magnet House, Kingsway, London, W.C.2, a British company, do hereby declare the nature of this invention (a communication from Patent-Treuhand-Gesellschaft für Elektrische Glühlampen m.b.H., of 11/14, Ehrenbergstrasse, Berlin, O.17, Germany, a German company) to be as follows:—

This invention relates to electric discharge lamps of the type in which the discharge passes between thermionic electrodes (usually but not necessarily heated by the discharge only) separated by a distance much less than the diameter of an approximately spherical envelope in which they are contained, the said envelope during operation containing metal (usually mercury) vapour at a pressure considerably exceeding atmospheric (usually exceeding 20 atmospheres).

Such lamps are used largely as sources in optical projection apparatus, so that light is required from them in one direction only. Deposition of dark material on the walls does not therefore matter, so long as the material is kept away from the part of the wall through which the useful light is to be emitted. The object of this invention is to provide means for this purpose.

According to the invention, a lamp of the type specified comprises a hood (or hoods) behind one (or both) of the electrodes, whereby, when the lamp is burnt with the discharge path between the electrodes vertical, most of the solid material entering the gaseous filling is deposited on one or other of the said hoods. Preferably each hood is so shaped that it serves the subsidiary purpose of preventing wandering of the discharge column. In this statement "behind an electrode" means on the line joining the electrodes and mainly on the side of the electrode remote from the other electrode.

One embodiment of the invention will now be described by way of example with reference to the accompanying drawing, which shows a longitudinal section of a lamp of the type specified.

The approximately spherical envelope 1, of quartz or other refractory vitreous material, contains the two electrodes 2, 3 supported on leading-in-wires 5, 6, issuing at opposite ends of the envelope and surrounded by sheaths 7, 8. If the envelope is of quartz, intermediate glasses (not shown) may be used in sealing the wires 5, 6, through the envelope. The electrodes 2, 3 may be of any of the known kinds adapted to be heated by the discharge so as to emit thermionically; they are shown as perforated tungsten canisters containing alkaline earth oxide. The distance between the nearest points of the electrodes is a few millimetres and much less than the shortest diameter of the envelope 1. The envelope is filled with neon at 5 mm. pressure, and contains a quantity of mercury 4, so chosen that it is all evaporated when the lamp is in full operation.

According to the invention, an open hood 9 of vitreous material, which may or may not be the same as that of the envelope, is supported behind the electrode 2 and coaxial with it by stems 10 joining it to the envelope. In order that the envelope behind the hood may not be too cool, it may be provided with a reflecting coating 11.

The lamp is adapted to be operated in the position shown, namely with the line joining the electrodes vertical and with electrode 2 uppermost. Convection currents in the mercury vapour, flowing through the hood, will then tend to deposit all solid material from the electrodes, or other sources, on the interior of the hood 10 and not on the part of the envelope between the electrodes through which the useful light emerges; these convection currents will tend at the same time to prevent the discharge column from wandering.

[Price 1/-]
Revised price 2s. 6d

Dated the 25th day of September, 1936.

For the Applicants,
NORMAN R. CAMPBELL.

PROVISIONAL SPECIFICATION
No. 13423 A.D. 1937.

Improvements in or relating to High-Pressure Metal-Vapour Electric Discharge Devices

We, THE GENERAL ELECTRIC COMPANY LIMITED, of Magnet House, Kingsway, London, W.C.2, a British company, do hereby declare the nature of this invention (a communication from Patent-Treuhand-Gesellschaft für elektrische Glühlampen m.b.H., of 11/14, Ehrenbergstrasse, Berlin, O.17, Germany, a German company) to be as follows:—

This invention relates to high-pressure metal-vapour electric discharge (HPMV) lamps of the type wherein the thermionic electrodes between which the discharge passes are separated by a distance much less than the diameter of an approximately spherical envelope in which they are contained, the said envelope containing mercury (possibly with the addition of other metals) at a pressure considerably exceeding atmospheric and usually exceeding 20 atmospheres.

In co-pending application No. 26058/36 it is proposed to provide lamps of the type specified with a hood (or hoods) behind one or both of the electrodes whereby, when the lamp is burnt with the discharge path between the electrodes vertical, most of the solid material entering the gaseous filling is deposited on one or other of the said hoods. The object of this invention is to provide convenient constructions for such lamps provided with hoods, or for modifications of them in which the hood is adapted to lie above the discharge path when this path is horizontal.

Four embodiments of the present invention will now be described by way of example with reference to the accompanying drawings in which Figures 2, 3, 4, 5 each show a longitudinal section through a lamp. Corresponding numerals denote corresponding parts in all figures.

In Figure 2 the envelope 1 of thick quartz is spherical; it contains electrodes 2, 3 of known kind lying a few millimetres apart along a diameter which is horizontal when the lamp is in operation. Both supporting leads are brought to a single cap through the same seal; the outer surface of the ceramic tube 4 enclosing this seal is unglazed; a rough surface helps to keep the seal cool. Above the discharge path between the electrodes is the quartz hood 9, which may be supported either by rods 10 from the envelope or by a wire 10^1 from the seal or from the leads issuing from the seal.

In Figure 3 the electrodes 2 and 3 lie along a vertical line. The upper electrode 3 is supported from the seal below both electrodes by the lead 13 shielded by the quartz or ceramic shield 14. The hood 9 is supported behind the electrode 3 by two quartz rings 15 sealed to the envelope and pierced with holes 15^1, preferably staggered; the deposition of solid matter from the gas, carried through the hood by convection currents, is thereby promoted. 11 is a reflecting coating on the outside of the top of the envelope.

In Figure 4 the electrodes 2, 3 are inclined to the vertical, but the discharge path is adapted to be horizontal. They are carried on leads 19, bowed outwards just above the electrodes and supporting the hood 9 which is a mass of quartz 16 having a central bore 17 and lateral canals 18 leading from it to the outside. The upper outer rim 20 of the mass abuts against the envelope.

Figure 5 differs from Figure 4 in that the hood 9 is a conical frustrum surrounded by a baffle 21. The hood does not abut against the envelope.

In any of the constructions shown the hood may be of ceramic material instead of quartz or even of metal. Additional members to guide the convection currents may also be added.

The density of the gaseous medium within the lamp during operation must always be so great that the convection is sufficient to carry the solid matter into the hood. It is permissible to place on or near the electrodes salts or like materials of known kind whose vapour modifies the colour of the light; for any solid matter resulting from them will be carried into the hood and not obstruct the emission of the useful light. Lamps according to the invention do not generally need artificial cooling, but it may be applied.

Dated the 11th day of May, 1937.

For the Applicants.
NORMAN R. CAMPBELL.

COMPLETE SPECIFICATION

Improvements in or relating to High-Pressure Metal-Vapour Electric Discharge Lamps

We, THE GENERAL ELECTRIC COMPANY LIMITED, of Magnet House, Kingsway, London, W.C.2, a British company, do hereby declare the nature of this invention (a communication from Patent-Treuhand-Gesellschaft für elektrische Glühlampen m.b.H., of 11/14, Ehrenbergstrasse, Berlin, O.17, Germany, a German company) and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to electric discharge lamps of the type in which the discharge passes between thermionic electrodes (usually but not necessarily heated by the discharge only) contained in an envelope that does not approach them nearly, the said envelope during operation containing metal (usually mercury) vapour at a pressure considerably exceeding atmospheric (usually exceeding 20 atmospheres).

Such lamps are used largely as sources in optical projection apparatus, so that light is required from them in one direction only. Deposition of dark material on the walls does not therefore matter, so long as the material is kept away from the part of the wall through which the useful light is to be emitted. The object of this invention is to provide means for this purpose.

According to the invention, an electric discharge lamp of the type specified comprises a hood open at both ends, above the electrodes, whereby, when the lamp is operated with the discharge path between the electrodes below the lower aperture of the hood, convection currents enter the lower apertures and leave the upper aperture(s), so that most or all of the solid material entering the gaseous filling is deposited on the said hood. The hood will then usually serve the subsidiary purpose of preventing wandering of the discharge column; this function may be taken into consideration in designing it. In this statement "above the electrode" means that if the lamp is arranged with a certain line in it vertical (which line will usually be the line joining the electrodes or a line perpendicular to the line joining the electrodes), then the hood is either wholly above or wholly below both electrodes. The electrodes here mean the surfaces on which the discharge actually terminates; these are usually the parts of the surface of the electrode structure most closely adjacent.

It will be observed that if the convection currents are to pass up through the hood and down outside it, the envelope must be of considerable width. This, but no more, is implied by the phrase "does not approach them nearly" in the description of the type specified.

Certain embodiments of the invention will now be described by way of example with reference to the drawing accompanying provisional specification No. 26058/36 (hereinafter called Figure 1) and to Figures 2, 3, 4, 5 of the drawings accompanying provisional specification No. 13423/37, each of which shows a longitudinal section of a lamp of the type specified. Corresponding numerals represent corresponding parts in all figures.

In Figure 1 the envelope 1, of quartz or other refractory vitreous material, approximately spherical in its lower part contains the two electrodes 2, 3 supported on leading-in-wires 5, 6, issuing at opposite ends of the envelope and surrounded by vitreous sheaths 7, 8. If the envelope is of quartz, intermediate glasses (not shown) may be used in sealing the wires 5, 6, through the envelope. The electrode structures 2, 3 may be of any of the known kinds adapted to be heated by the discharge so as to emit thermionically; they are shown as perforated tungsten canisters containing alkaline earth oxide. The distance between the nearest points of the electrode structures, which are the electrodes, is a few millimetres and much less than the perpendicular (or indeed any) diameter of the envelope 1. The envelope is filled with neon at 5 mm. pressure, and contains a quantity of mercury 4, so chosen that it is all evaporated when the lamp is in full operation.

According to the invention a hood 9 of vitreous material, which may or may not be the same as that of the envelope, is supported, so that it surrounds the line joining the electrode structures 2, 3 and is behind most of the structure 2, by stems 10 joining it to the envelope. The hood is open at both ends and wider below than above. In order that the envelope behind the hood may not be too cool, it may be provided with a reflecting coating 11.

The lamp is adapted to be operated in the position shown, namely with the dis-

charge path vertical and with structure 2 uppermost. Convection currents in the mercury vapour, flowing through the hood, will then tend to deposit all solid material from the electrode structures, or other sources, on the interior of the hood 10 and not on the part of the envelope opposite the discharge path, through which the useful light emerges; these convection currents will tend at the same time to prevent the discharge column from wandering.

In this embodiment one lead issues from the lamp above one below. When a lamp of the type specified is to be operated vertically, it is generally preferable that both leads should issue from the lower end. The remaining embodiments possess this feature.

Figure 2 differs from Figure 1 in that the line joining the electrodes is horizontal and not vertical and in that the seal through which the leads issue is of special construction described hereinafter. The surface of the ceramic tube 4 enclosing the seal is unglazed; a rough surface helps to keep the seal cool. The envelope 1 is of quartz. The stems 10 supporting the hood 9 from the envelope 1 may be replaced by the wire 10^1, shown dotted in Figure 2, supported at its lower end by being fused into the end of the said seal.

In Figure 3 the electrode structures 2 and 3 lie along a vertical line, as in Figure 1. The upper structure 3 is supported from the seal below both structures by the lead 13 shielded by the quartz or ceramic shield 14. The hood 9 is supported behind the structure 3 by two quartz rings 15 sealed to the envelope and pierced with holes 15^1, preferably staggered; the deposition of solid matter from the gas, carried through the hood by convection currents, is thereby promoted. The seal again is described hereinafter. 11 is a reflecting coating on the outside of the top of the envelope.

In Figure 4 the electrode structures 2, 3 are inclined to the vertical, but the discharge path will be substantially horizontal, if the lamp is operated in the position shown. They are carried on leads 19, bowed outwards just above the electrodes and supporting the hood 9 which is a mass of quartz 16 having a central bore 17 and lateral canals 18 leading from it to the outside. The upper outer rim 20 of the mass abuts against the envelope.

Figure 5 differs from Figure 4 in that the hood 9 is a conical frustrum surrounded by a baffle 21. The hood does not abut against the envelope.

In any of the constructions shown the hood may be of ceramic material instead of quartz or even of metal. Additional members to guide the convection currents may also be added.

The density of the gaseous medium within the lamp during operation must always be so great that the convection is sufficient to carry the solid matter into the hood. It is permissible to place on or near the electrodes salts or like materials of known kind whose vapour modifies the colour of the light; for any solid matter resulting from them will be carried into the hood and not obstruct the emission of the useful light. Lamps according to the invention do not generally need artificial cooling, but it may be applied.

The seals aforementioned will now be described. It is known that a strip of molybdenum not more than 20μ thick can be sealed through quartz by placing it within a tube of quartz, evacuating the tube or otherwise freeing it from gases that might attack the metal, applying heat externally to the tube and thereby causing the quartz to collapse onto the strip. Both the seals aforementioned are made by a modification of this process in which two thin molybdenum strips are arranged in the substantially cylindrical space between an outer tube of quartz and a core of quartz, the lengths of the strips being substantially parallel to the axis of the said space, and the outer tube is then caused to collapse onto the said strips and core by heat applied to it externally.

In each of the seals shown in Figures 2, 3, 4, 5 the two molybdenum strips 8 are shown lying between the core 7 and the outer tube 6 which has been collapsed onto them. In each of them the core is tubular; during the collapsing of the outer tube a pressure slightly above atmospheric is maintained within the core, so that the core may not collapse and may even expand. In each seal the outer tube is provided at the inner end with a flange 5, by which it is sealed to the envelope when the seal has been made; during the sealing of the flange to the envelope, the envelope is filled with neutral gas so that the exposed metallic parts are not affected by heat. The seals of Figures 2 and 3 are each protected by a ceramic member 4, attached with cement, which acts also as a cap and carries the terminals; in Figure 3 the member 4 is provided with holes 24 to admit air to cool the exterior of the seal.

In the seals of Figure 3, 4, 5 the tubular core is closed at the inner end; but in the seal of Figure 2 it is hollow throughout and serves as the pumping tube of the lamp. Moreover the seal of

Figure 2 is broken half-way by the enlargement 22 of the outer tube; through the evacuated space between the enlargement 22 and the core 6 pass stouter molybdenum wires 23 joining the strips on either side. The object of this break is to prevent oxidation of the molybdenum leads, starting outside, from spreading down the whole length of the leads.

We are aware that Patent Specification No. 462,806, published after the date of provisional specification No. 26058/36, but before the date of provisional specification No. 13423/37, claims (in effect) an electric discharge lamp of the type specified comprising one or more shields conserving the heat of the electrodes and/or preventing the incidence of thermal radiation on the seals of the leading-in-wires and/or preventing the deposition of sputtered or evaporated material on the walls; further it claims such a lamp wherein at least one of the said shields surrounds an electrode. We make no claim to any such lamp unless it has one, and only one, shield that is a hood above the electrodes, open at both ends as aforesaid.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim subject to the foregoing disclaimer is:—

1. An electric discharge lamp of the type specified comprising a hood, open at both ends, above the electrodes, whereby, when the lamp is operated with the discharge path between the electrodes below the lower aperture of the hood, convection currents enter the lower aperture of the hood and leave the upper apertures, so that most or all of the solid material entering the gaseous filling is deposited on the said hood.

2. An electric discharge lamp according to Claim 1, wherein the leads to both of the electrodes are taken out through the end of the envelope that is lower in operation.

3. An electric discharge lamp according to Claim 1, wherein both the said leads pass through a common seal.

4. An electric discharge lamp substantially as hereinbefore described with reference to the drawing accompanying provisional specification No. 26058/36 or with reference to any of the Figures of the drawings accompanying provisional specification No. 13423/37.

Dated the 16th day of July, 1937.

For the Applicants,
NORMAN R. CAMPBELL.

[This Drawing is a reproduction of the Original on a reduced scale.]

FIG.2

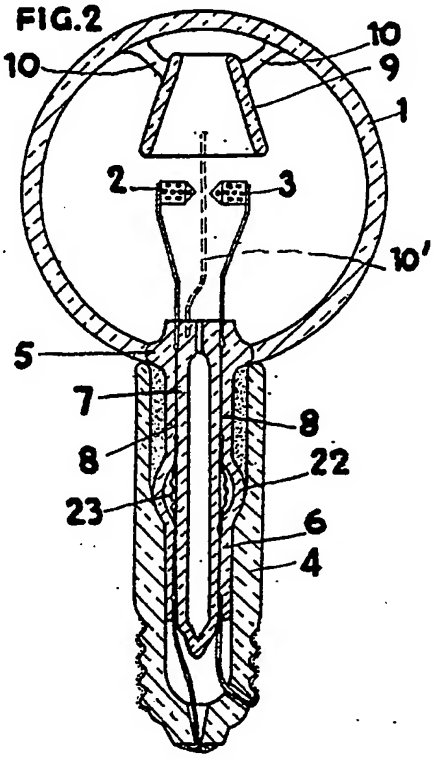


FIG.3

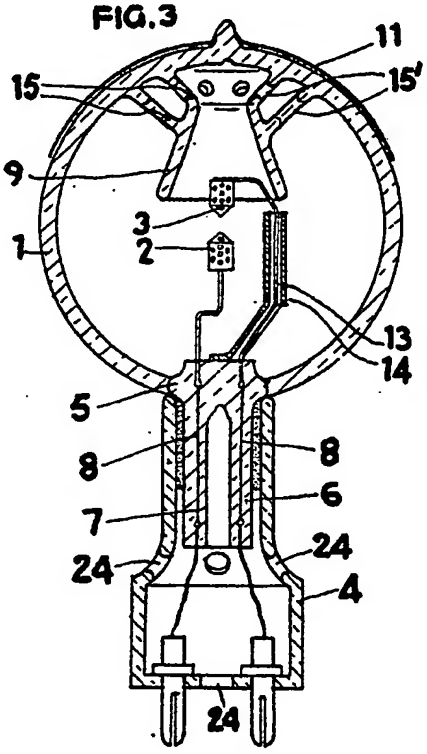


FIG.4

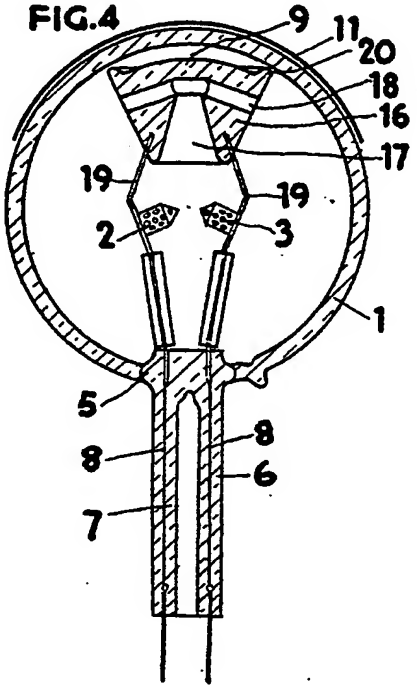
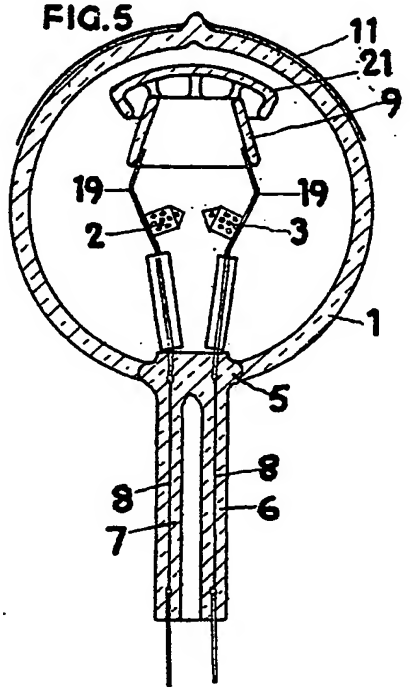


FIG.5



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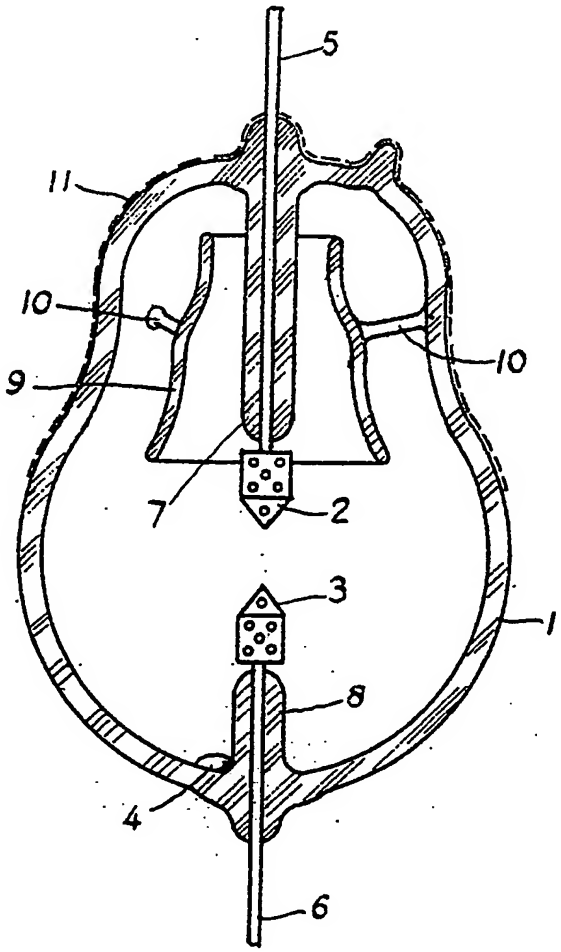
[This Drawing is a full-size reproduction of the Original.]



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